DOI: https://doi.org/10.2298/SARH190901003J
UDC: 616.718.5-001.5-089

ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Single center experience in treatment of tibial shaft fractures using the Ilizarov technique

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SUMMARY
Introduction/Objective Since tibial shaft is a common location of opened and closed tibial fractures, it is very important to determine the best method of treating these fractures.
Our objective was to assess whether the Ilizarov technique is appropriate in terms of complications, outcomes, and pain reduction in treatment of patients with tibial shaft fracture.
Methods Retrospective analysis included all consecutive patients with tibial shaft fracture treated with the Ilizarov technique in the period from January 2013 to June 2017 at the Banjica Institute for Orthopaedic Surgery, Belgrade, Serbia. Demographic and clinical data on patients were collected. Pain was assessed using visual analogue scale of pain. Two models of uni- and multi-variate linear regression analysis were performed.
Results The study showed that the overall rate of complications was low, and that hypertension, administration of antibiotics, and reoperation prolonged fixation. Also, severe fractures and longer procedure time delay mobilization. Significant reduction of pain was observed.
Conclusion The Ilizarov technique is a safe and reliable method in the treatment of patients with tibial shaft fractures and is followed by pain reduction, overall improvement of functioning, good outcomes, and is not commonly associated with complications.
Keywords: Ilizarov technique; tibial shaft fracture; disability; functionality; satisfaction; outcome

INTRODUCTION

Tibial shaft is a common location of opened and closed tibial fractures. Opened tibial fractures develop as a consequence of strong force effects, usually seen in traffic accidents [1, 2]. Along with the increased use of motor vehicles and consequential increase of trauma, it is very important to determine the best method and timing of treating tibial shaft fractures [3, 4].

Segmental fractures of tibia are rare, accounting for only 12% of all tibial fractures. It is not unusual for them to be associated with different complications such as malunion and infections. In this case, it is also inconclusive which treatment option to choose and this issue stays unclear and undefined [5, 6].

The generally used treatment method for tibial shaft fractures is still an interlocking nail. This therapeutic approach has its advantages in terms of good mobilization of the patient and prompt return to the usual activities. However, some cohort studies have shown that this approach may be associated with high rate of complications after the insertion of the interlocking nail [7, 8, 9]. The alternative method primarily for opened and complicated fractures is the external Ilizarov fixation. This is considered to be an efficient and safe method [6, 8, 10]. Its unique biomechanical characteristics provide the formation of elastic wires under the tension and maintain stable fixation of bone fragments, while allowing dynamization at the place of fracture. For successful treatment, it is necessary to put the wires under certain tension, which should be maintained during the whole period of treatment [11]. The weakening of tension, loosening of wires or even their breaking add to the instability which further causes deformities and delayed healing of fracture.

External fixation using the Ilizarov fixator is used for treating tibial plateau fractures as well. The majority of the literature data indicate that it is an equally efficient, if not an even more efficient method, in the treatment of tibial plateau fractures, compared to internal fixation [12, 13].

However, treatment of tibial fractures using Ilizarov fixator can be associated with certain complications, especially in cases involving large bone and surrounding soft tissue defects. The most common complications include infection of the surgical region, osteomyelitis, axial deviation, delayed union or malunion [14, 15].

Considering the fact that there is no consensus concerning the best surgical approach for tibial shaft fractures and the lack of studies investigating the long-term prognosis in patients treated with the Ilizarov fixator, the objective of our study was to retrospectively

Received • Примљено: September 1, 2019
Revised • Ревизија: December 5, 2019
Accepted • Прихваћено: December 31, 2019
Online first: January 13, 2020

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analyze patients with tibial shaft fractures in terms of pain, complications, and to determine which characteristics represent significant predictors of the postoperative course.

METHODS

In this retrospective analysis we aimed to review the postoperative course in terms of complications, pain, and to determine which demographic and clinical characteristics of patients represented significant predictors of postoperative course.

The study was conducted at the Banjica Institute for orthopedic surgery, Belgrade, Serbia, in the period from January 2013 to June 2017 and included all consecutive patients with a radiographically confirmed tibial shaft fracture treated with the Ilizarov technique. Classification of tibial fractures was according to the Orthopedic Trauma Association classification system. All fractures were classified as A, B, or C type, in accordance with the radiological finding.

Demographic and clinical characteristics of patients were obtained from their medical records. The following characteristics were analyzed: age, sex, chronic diseases, duration of hospitalization (in days), duration of waiting for the procedure (in days), duration of surgical procedure (in minutes), type of anesthesia, type of fracture, the manner of injury, prophylaxis (antibiotics, nadroparin calcium), complications after the procedure, as well as the duration of fixation. Complications that were analyzed included superficial and deep infection, nonunion, pseudoarthrosis, compartment syndrome, and reoperation.

Intensity of pain at the moment of admission and after a period of recovery, that is, when the Ilizarov fixator was removed, was assessed using visual analog scale (VAS). VAS consisted of a continuous scale that can be horizontal or vertical and is 100 mm in length. It is marked with two perpendicular labels at the end of the 100 mm line that represent the extreme values, i.e. minimal and maximal possible pain in the last 24 hours. VAS is designed to be filled out by the participants themselves. Scoring is performed using the ruler that measures the length from the beginning of the line to the label the participants gave, which represents the intensity of pain from 0 to 100; higher scores indicate higher pain intensity [16].

In order to describe the study sample, measures of descriptive statistics were used: mean values, standard deviation, and relative numbers (percentages). The normality of distribution was assessed using the Kolmogorov–Smirnov test. The differences between groups were evaluated using the Student's t-test. To estimate which characteristics of the participants represent significant predictors of pain, complications, and duration of fixation, we performed two models of linear regression analysis. In the first model, independent variables were clinical and demographic characteristics of patients, while the independent variable was the duration of fixation. In the second model, the independent variables were the same as in the first one, while the dependent variable was mobilization in days. P-values less than 0.05 were considered statistically significant. Statistical analysis was performed using SPSS (Statistical Package for Social Sciences), version 22.0 (SPSS Inc, Chicago, IL, USA).

This research was approved by the Council of the Banjica Institute for Orthopedic Surgery and the Ethical Committee of the Faculty of Medicine, University of Belgrade, with the decision that this type of study (retrospective study) does not need any written consent from the patients since it covers the period before the research has been initiated. However, the investigators are under the obligation to keep all personal information on study subjects strictly confidential. All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

RESULTS

The average age at admission to the hospital was 47.8 ± 16 years; 63.5% of patients were men and 36.5% were women. Diabetes mellitus was present in 12.2%, hypertension in 28.4%, while coronary artery disease in only 2.7% of patients.

The average duration of hospitalization was 26.5 ± 13.3 days (range 13–85 days), while patients waited for the procedure 7.5 ± 8.1 days, (range 1–61), since the day of admission.

Most of the patients received spinal anesthesia (75.7%), block anesthesia (16.2%), while the least number of them underwent total anesthesia (8.1%).

The average duration of surgical procedure was 68.2 ± 25.8 minutes (range 30–165 minutes). None of the patients received blood transfusion during the procedure.

In the majority of patients (70.3%), A type of fracture occurred. However, a significant proportion of patients (20.3%) had complicated C type of fracture, while B type of fracture occurred in 9.5% of patients. The most frequent manner of injuring were same level falls (67.6%), while falls from height were the rarest manner of injuring (8.1%). Direct force caused trauma in 10.8%, while traffic accidents caused trauma in 13.5% of patients.

An antibiotic was administered in 24.3% of the patients, while nadroparin calcium (Fraxiparine®, Aspen Notre-Dame-de-Bondeville, France) was administered in the majority of patients in the aim of thrombosis prevention (97.3% of cases).

Considering the rate of complications, the overall rate was low; 5.4% of patients underwent the repeated surgical procedure and only 2.7% of patients had pseudo-arthrosis.

The highest value on VAS was observed at the place of fracture, which was expected. This high score remained even after removing the Ilizarov fixator. However, there was a significant difference in pain intensity before and after the procedure, and for each location where pain was assessed (knee, ankle joint, place of fracture). These results are given in Tables 1 and 2.

Table 1. The average pain scores on the visual analogue scale (VAS) on admission and after treatment

Pain (VAS)	On admission		At the end of the treatment	
	Mean	SD	Mean	SD
Knee	64.52	10.15	20.27	8.97
Ankle joint	69.25	13.09	20.27	8.97
Place of fracture	81.64	10.38	23.9	10.52

Table 2. The reduction of pain during the treatment (fixation)

Differences in pain intensity (VAS)	Mean	SD	t-test	p
Knee	44.26	13.79	27.606	< 0.001
Ankle joint	48.11	16.97	24.379	< 0.001
Place of fracture	57.63	16.14	30.723	< 0.001

VAS – visual analogue scale

Table 3 shows the results of uni- and multi-variate linear regression analysis with the duration of fixation, as an independent variable. The average duration of fixation was 6.2 ± 1.9 months. Univariate model showed that significant predictors of the duration of therapy, i.e. the duration of fixation, were the presence of hypertension ($p = 0.057$), antibiotic prophylaxis ($p = 0.029$), repeated surgical procedure ($p < 0.001$), and the presence of pseudo-arthrosis ($p = 0.002$). These variables entered the model of multivariate linear regression analysis where all variables, except pseudo-arthrosis, remained the significant predictors of the duration of fixation. Patients with hypertension ($p = 0.040$) were at greater risk of longer therapy duration, as well as those who were on an antibiotic therapy ($p = 0.012$) and those who underwent the repeated surgical procedure ($p = 0.021$).

The results of uni- and multi-variate linear regression analysis with the mobilization as a dependent variable are shown in Table 4. The average time of mobilization was 1.3 ± 0.5 days. Univariate linear regression analysis has shown that the duration of procedure, type of fracture, and the manner of injury are significant predictors for

Table 3. Uni- and multi-variate regression analysis with the duration of fixation as an independent variable

Independent variable	Univariate linear regression analysis			Multivariate linear regression analysis		
	β coefficient	IR*	p	β coefficient	IR*	p
Sex	-0.049	-1.115–0.735	0.683			
Age	0.214	-0.002–0.053	0.069			
Diabetes mellitus	0.167	-0.379–2.302	0.157			
Hypertension	0.225	-0.023–1.901	**0.057**	0.220	0.045–1.792	**0.040**
Coronary vascular disease	-0.130	-4.219–1.211	0.273			
Other	0.047	-0.911–1.357	0.696			
Total duration of hospitalization	0.165	-0.010–0.057	0.162			
Waiting for the intervention	-0.036	-0.071–0.041	0.594			
Type of anaesthesia	0.081	-0.472–0.964	0.497			
Duration of procedure	1.023	-0.008–0.026	0.310			
Type of fracture	0.140	-0.220–0.869	0.239			
Manner of injury	0.061	-0.296–0.504	0.606			
Antibiotics	0.255	0.117–2.122	**0.029**	0.261	0.258–2.034	**0.012**
Fraxiparine	-0.137	-4.294–1.132	0.249			
Reoperation	0.451	1.190–5.496	**< 0.001**	0.345	0.447–5.237	**0.021**
Pseudo-arthrosis	0.359	1.595–6.707	**0.002**	0.79	-2.030–4.721	0.429

Table 4. Uni- and multi-variate linear regression analysis with mobilization as independent variable

Independent variable	Univariate linear regression analysis			Multivariate linear regression analysis		
	β coefficient	IR*	p	β coefficient	IR*	p
Sex	0.171	-0.060–0.395	0.146			
Age	-0.180	-0.112–0.001	0.124			
Diabetes mellitus	-0.178	-0.593–0.076	0.128			
Hypertension	-0.069	-0.319–0.173	0.557			
Coronary vascular disease	-0.119	-1.028–0.333	0.312			
Other	0.020	-0.260–0.307	0.868			
Total duration of hospitalization	0.956	-0.004–0.012	0.324			
Waiting for the intervention	0.158	-0.004–0.023	0.178			
Type of anaesthesia	-0.098	-0.254–0.104	0.408			
Duration of procedure	0.445	0.004–0.012	**< 0.001**	0.385	0.004–0.011	**< 0.001**
Type of fracture	0.512	0.181–0.417	**< 0.001**	4.113	0.004–0.011	**< 0.001**
Manner of injury	0.242	0.006–0.200	**0.037**	0.061	-0.082–0.087	0.952
Antibiotics	0.061	-0.191–0.326	0.605			
Fraxiparine®	0.119	-0.333–1.028	0.312			
Reoperation	-0.044	-0.548–0.398	0.707			
Pseudo-arthrosis	-0.119	-1.028–0.333	0.312			

mobilization time ($p < 0.001$, $p < 0.001$, and $p = 0.037$, respectively). These three variables entered the model of multivariate linear regression analysis, which showed that the duration of procedure and the type of fracture were independent predictors of mobilization, while the manner of injury has not remained significant ($p = 0.952$). Patients with more severe fractures ($p < 0.001$) and those who underwent longer procedures could stand on their feet later, compared to those with shorter procedure times ($p < 0.001$).

DISCUSSION

We observed that the overall rate of complications in our study was low, with only 5% of patients undergoing repeated surgical procedure and about 2% with pseudo-arthrosis. There were no other complications observed. In the study by Lan et al. [17], which investigated the outcomes after the lengthening procedure, and compared the Ilizarov technique with nailing, one of the outcome measures after the Ilizarov technique was also the complications rate. They followed the rate of pin-site infections and deep infections. The rate of pin-site or superficial infections was about 2%, and there were no deep infections observed. Our results are in concordance with this study. Pin sites may become colonized with bacteria and much shorter time needed for external fixation may be the possible explanation for low rate of infections in this group of patients. In other studies, the rates of infections were 1.7–21%, but bony union rates were high only when the nail was inserted after the initial external fixation, for high energy and opened tibial fractures [18, 19, 20]. However, in the study by Lan et al. [17], all tibiae were well vascularized, which could also be an explanation to the low rate of infection. In our sample, the majority of cases were non-complicated fractures, which is a possible explanation for the findings. However, we had a significant percentage of complicated fractures without any infection as a complication and this goes in favor of the Ilizarov technique, in terms of safety and good outcomes.

Some authors found that nonunion represented a relatively frequent complication. Surgery to treat pseudo-arthrosis and nonunion is difficult and can be a serious problem, followed by severe complications [21, 22]. In their study, Gulabi et al. [23] stated that nonunion was the result of closed fractures in two patients and opened fractures in three patients. Our results are in accordance with these studies, considering the fact that in our sample nonunion was a result of complicated fracture.

In the study by Sen et al. [24], the rate of complications was 2.08% per patient. Other studies reported the rate of 2.2 complications per patient and 2.5 complications per patient, respectively [25, 26]. The study by Gulabi et al. [23] reported the rate of 2.6 complications per patient, but most of them were minor and could be resolved without any additional surgical procedure. Only one patient had deep chronic bone infection, so he had to be re-operated. Although in our study the rate of complications was not calculated per patient, the overall rate was presented so the results could not be adequately compared. We can conclude that in all the studies using the Ilizarov external fixation, the rate of complications was low and our results are in accordance to theirs. This further implicates that the Ilizarov fixation method is safe and provides good results. In addition, the results of Meleppuram and Ibrahim [27] showed the similar rate of complications per patient, which was 1.6.

Tibial fractures range from low-energy injures, like in women with osteoporosis, to high-energy injures with severe soft tissue damage, along with bone trauma. The most common clinical finding associated with tibial fracture is soft tissue damage. This injury is particularly serious when there is metaphysial-diaphyseal dissociation. The treatment of such injures with external fixation dramatically improved results. The advantage of the Ilizarov fixator over closed fixation is that it allows closed reduction, minimal soft tissue damage, early mobilization, and a minor procedure of removal of the Ilizarov fixator [28]. Our results are in concordance with these particular findings. We have also shown that complicated fractures and longer duration of the procedure postponed mobilization time. However, we could not compare our results with previously mentioned study since the authors have not investigated the predictors of faster mobilization.

Early removal of external fixation reduces the risk of complications, i.e. the risk of infections, and allows earlier rehabilitation [23]. One of the objectives of our study was to show how certain demographic and clinical characteristics of patients influence the length of fixator carrying – the time of fixator removal. We have shown that patients with hypertension, those who received antibiotic therapy, and those who underwent repeated surgical procedures were at greater risk of later removal of fixation. In other words, we may say that complications (repeated procedure in our sample) delay the removal of fixation and that further leads to other complications, such as infections.

The Ilizarov technique offers an effective and safe manner of treating some of the most challenging conditions in orthopedics, such as complicated fractures, infected fractures, or nonunions of tibia. In our study, the average duration of fixation was about six months, which is slightly shorter than in the study by Meleppuram and Ibrahim [27], who showed that the average duration of fixation was 8–10 months. Some studies have shown that smoking had negative effects on fixation, in terms of lengthening the time of fixation, as well as on bone lengthening index [29]. We have not investigated the influence of smoking status on the duration of fixation, but, as it was already mentioned, we have shown that hypertension, repeated procedure, and the use of antibiotics were independent predictors of fixation duration.

We have investigated the functionality after the procedure – the pain and the reduction of pain after fixation. We have observed that the reduction of pain was significant, even in those with complicated fractures. The other authors also measured functionality after procedure. Meleppuram and Ibrahim [27] showed good bone results in 60% of patients, but functional results were worse than bone results. It shows that excellent bone results do not guarantee good functionality. Functional results, as well as the pain reduction, are affected by damage of soft tissue and neurovascular structures. There are many published papers investigating long bone defect managing and describing complications, but pain, long treatment process, and prolonged external fixation are the main shortcomings. This could be a significant physical and mental burden for the patient. The study by Wang et al. [30], which investigated the overall wellbeing and pain after the Ilizarov fixation, showed that treatment deteriorated physical and emotional wellbeing and patients experienced severe pain for a long time. At the end of the follow-up, although with severe pain, the overall functioning was significantly improved. Our results differ significantly from these findings. This study included only patients with infected tibial nonunions, unlike our sample, which involved patients with less complicated fractures as well, which could be the possible explanation for the different results.

Our study has some limitations. Firstly, although we analyzed the representative sample of all consecutive patients with tibial shaft fractures in a given period, sample size is still small, which can disable the generalization of the results. In addition, we used only VAS without analyzing the overall physical and mental condition of the patients, so we cannot have the comprehensive view on the situation. Furthermore, this is a retrospective analysis that relied on medical records of the patients, and not a prospective one, where we could further follow the outpatients. Clinical data were taken from the medical history of a patient that had been obtained partly by the anesthesiologist and partly by the orthopedic surgeon, which could affect the consistency of data and further results. Also, the small number of studies investigating this medical problem in the manner we did make the comparison difficult.

CONCLUSION

In conclusion, we may say that the Ilizarov technique in the treatment of tibial shaft fractures is a safe and reliable method, not commonly associated with complications, and is characterized by pain reduction, overall improvement of functioning, and good outcomes. It is important for surgeons to consider the factors influencing the outcome, such as the duration of fixation, pain, and mobilization time, so that they could better cope with the problem of their patient at an individual level.

Conflict of interest: None declared.

REFERENCES

1. Laurila J, Huttunen TT, Kannus P, Kääriäinen M, Mattila VM. Tibial shaft fractures in Finland between 1997 and 2014. Injury. 2019;50(4):973–7.
2. Larsen P, Elsoe R, Hansen SH, Graven-Nielsen T, Laessoe U, Rasmussen S. Incidence and epidemiology of tibial shaft fractures. Injury. 2015;46(4):746–50.
3. Foote CJ, Guyatt GH, Vignesh KN, Mundi R, Chaudhry H, Heels-Ansdell D, et al. Which Surgical Treatment for Open Tibial Shaft Fractures Results in the Fewest Reoperations? A Network Meta-analysis. Clin Orthop Relat Res. 2015;473(7):2179–92.
4. Duyos OA, Beaton-Comulada D, Davila-Parrilla A, Perez-Lopez JC, Ortiz K, Foy-Parrilla C, et al. Management of Open Tibial Shaft Fractures: Does the Timing of Surgery Affect Outcomes? J Am Acad Orthop Surg. 2017;25(3):230–8.
5. Teraa M, Blokhuis TJ, Tang L, Leenen LP. Segmental tibial fractures: an infrequent but demanding injury. Clin Orthop Relat Res. 2013;471(9):2790–6.
6. Foster PA, Barton SB, Jones SC, Morrison RJ, Britten S. The treatment of complex tibial shaft fractures by the Ilizarov method. J Bone Joint Surg Br. 2012;94(12):1678–83.
7. Bhandari M, Guyatt G, Tornetta P 3rd, Schemitsch EH, Swiontkowski M, Sanders D, et al. Randomized trial of reamed and unreamed intramedullary nailing of tibial shaft fractures. J Bone Joint Surg. 2008;90(12):2567–78.
8. Laigle M, Rony L, Pinet R, Lancigu R, Steiger V, Hubert L. Intramedullary nailing for adult open tibial shaft fracture. An 85-case series. Orthio Traumatol Surg Res. 2019;105(5):1021–4.
9. Whiting PS, Galat DD, Zirkle LG, Shaw MK, Galat JD. Risk Factors for Infection After Intramedullary Nailing of Open Tibial Shaft Fractures in Low- and Middle-Income Countries. J Orthop Trauma. 2019;33(6):e234–9.
10. Tomic S, Baljozovic A. Distal humerusnonunions after failed internal fixation – treatment with the Ilizarov external fixator. Srp Arh Celok Lek. 2018;146(3–4):169–73.
11. Ilizarov GA. Clinical application of the tension-stress effect for limb lengthening. Clin Orthop Relat Res. 1990;(250):8–26.
12. Tomic S, Baljozovic A, Jeremic D. High-energy tibial plateau fractures treated with Ilizarov fixator. Srp Arh Celok Lek. 2019;147(7–8):427–31.
13. Subramanyam KN, Tammanaiah M, Mundargi AV, Bhoskar RN, Reddy PS. Outcome of complex tibial plateau fractures with Ilizarov external fixation with or without minimal internal fixation. Chin J Traumatol. 2019;22(3):166–71.
14. Paley D, Maar DC. Ilizarov bone transport treatment for tibial defects. J Orthop Trauma. 2000;14(2):76–85.
15. Mostafa DG, Qavi MI, Bari MM, Arifuzzaman M, Kamruzzaman M, Saha MK. Evaluation of the Results of Ilizarov Ring Fixation in Schatzker TypeVI Tibial Plateau Fracture. Mymensingh Med J. 2018;27(1):136–43.
16. McCormack HM, Horne DJ, Sheather S. Clinical applications of visual analogue scales: a critical review. Psychol Med. 1988;18(4):1007–19.
17. Lan X, Zhang L, Tang P, Xia H, Li G, Peng A, et al. S-osteotomy with lengthening and then nailing compared with traditional Ilizarov method. Int Orthop (SICOT). 2013;37(10):1995–2000.
18. Maurer DJ, Merkow RL, Gustilo RB. Infection after intramedullary nailing of severe open tibial fractures initially treated with external fixation. J Bone Joint Surg Am. 1989;71(6):835–8.
19. Nowotarski PJ, Turen CH, Brumback RJ, Scarboro JM. Conversion of external fixation to intramedullary nailing for fractures of the shaft of the femur in multiply injured patients. J Bone Joint Surg Am. 2000;82(6):781–8.
20. Siebenrock KA, Schillig B, Jakob RP. Treatment of complex tibial shaft fractures. Arguments for early secondary intramedullary nailing. Clin Orthop Relat Res. 1993;(290):269–74.
21. Sala F, Thabet AM, Castelli F, Miller AN, Capitani D, Lovisetti G, et al. Bone transport for postinfectious segmental tibial bone defects with a combined Ilizarov/Taylor spatial frame technique. J Orthop Trauma. 2011;25(3):162–8.
22. Märdian S, Giesecke M, Haschke F, Tsitsilonis S, Wildemann B, Schwabe P. Treatment of Tibial Non-Unions - State of the Art and Future Implications. Acta Chir Orthop Traumatol Cech. 2016;83(6):367–74.
23. Gulabi D, Erdem M, Cecen GS, Avci CC, Saglam N, Saglam F. Ilizarov Fixator Combined with an Intramedullary Nail for Tibial Nonunions with Bone Loss: Is it Effective? Clin Orthop Relat Res. 2014;472(12):3892–901.
24. Sen C, Kocaoglu M, Eralp L, Gulsen M, Cinar M. Bifocal compression-distraction in the acute treatment of grade III open

tibia fractures with bone and soft-tissue loss: a report of 24 cases. J Orthop Trauma. 2004;18(3):150–7.
25. Saleh M, Rees A. Bifocal surgery for deformity and bone loss after lowerlimb fractures. Comparison of bone-transport and compression-distraction methods. J Bone Joint Surg Br. 1995;77(3):429–44.
26. Dendrinos GK, Kontos S, Lyritis E. Use of the Ilizarov technique for treatment of non-union of the tibia associated with infection. J Bone Joint Surg Am. 1995;77(6):835–46.
27. Meleppuram JJ, Ibrahim S. Experience in fixation of infected non-union tibia by Ilizarov technique – a retrospective study of 42 cases. Rev Bras Ortop. 2017;52(6):670–5.
28. Reddy S, Kumar Y, Shah HM, Golla DK, Ganesh N, Kumar A. Evaluation of Tibial Condyle Fractures Treated with Ilizarov Fixation, A Prospective Study. J Clin Diagn Res. 2014;8(11):LC05–7.
29. McKee MD, DiPasquale DJ, Wild LM, Stephen DJ, Kreder HJ,Schemitsch EH. The effect of smoking on clinical outcomeand complication rates following Ilizarov reconstruction. J Orthop Trauma. 2003;17(10):663–7.
30. Wang H, Wei X, Liu P, Fu Y, Wang P, Cong Y, et al. Quality of life and complications at the different stages of bone transport for treatment infected nonunion of the tibia. Medicine. 2017;96(45):e8569.

Искуство једног центра у третману прелома дијафизе тибије Илизаровљевом методом

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САЖЕТАК

Увод/Циљ Дијафиза тибије је често место настанка отворених и затворених прелома тибије, те је веома важно изабрати најбољи метод за третман ових повреда.

Циља рада је био да се процени да ли је Илизаровљева техника прикладна у смислу компликација, исхода лечења и редукције бола у третману болесника са преломом дијафизе тибије.

Методе Ретроспективна анализа је укључила све болеснике са преломом дијафизе тибије који су третирани Илизаровљевом методом у периоду од јануара 2013. до јуна 2017. године на Институту за ортопедско-хируршке болести „Бањица“ у Београду. Анализирани су демографски и клинички подаци о болесницима. Бол је процењен коришћењем визуелно-аналогне скале за бол. Коришћена су два модела униваријантне и мултиваријантне линеарне регресије за анализу података.

Резултати Резултати студије су показали мали број укупних компликација. Показано је да високе вредности крвног притиска, употреба антибиотика и реинтервенције продужавају фиксацију, као и тежина прелома и дужина интервенције. Такође је показано значајно смањење нивоа бола после интервенције.

Закључак Илизаровљева метода је сигурна и поуздана у третману болесника са преломом дијафизе тибије, праћена је смањењем јачине бола, свеукупним побољшањем функционалности и добрим исходом, и нема честе компликације.

Кључне речи: Илизаровљева метода; прелом дијафизе тибије; исход лечења; задовољство болесника лечењем